

## GERALD GENTLEMAN STATION UNITS 1&amp;2

## FLUE GAS DESULFURIZATION SYSTEMS

**SECTION 230500****GENERAL REQUIREMENTS FOR HVAC SYSTEMS****PART 1 – GENERAL**101. EXTENT

101.1 This Section covers the requirements for the engineering, design, manufacturing, testing, and commissioning of the heating and ventilating (H&V) systems.

101.2 Contractor shall engineer, design, furnish, install, test, and commission the following H&V systems for the following buildings:

- a. Unit 1 Absorber Building H&V System.
- b. Unit 2 Absorber Building H&V System.
- c. Gypsum Dewatering Building H&V System.
- d. Reactant Preparation Building H&V System.

102. RELATED WORK SPECIFIED IN OTHER SECTIONS

102.1 Section 011900 - Site Design Data.

102.2 Section 089100 - Louvers.

102.3 Section 230593 - Testing, Adjusting, and Balancing for HVAC.

102.4 Section 233313 - Dampers.

102.5 Section 233400 - HVAC Fans.

102.6 Section 238239 - Unit Heaters.

103. SYSTEM DESCRIPTION

103.1 HVAC System Design Criteria:

- a. The design of the HVAC systems shall be based on the outdoor design conditions in Section 011900 - Site Design Data.
- b. The design of the HVAC systems shall be based on maintaining the following indoor design conditions:

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| <u>System/Area</u>            | <u>Minimum Temperature</u> | <u>Maximum Temperature</u> | <u>Minimum Relative Humidity</u> | <u>Maximum Relative Humidity</u> |
|-------------------------------|----------------------------|----------------------------|----------------------------------|----------------------------------|
| Absorber Buildings            | 60°F                       | 104°F                      | ---                              | ---                              |
| Gypsum Dewatering Building    | 60°F                       | 104°F                      | ---                              | ---                              |
| Reactant Preparation Building | 60°F                       | 104°F                      | ---                              | ---                              |

- c. System Sizing:
  - c1. The heating and cooling required for each space shall be calculated in accordance with the methodology described in ASHRAE-183 and ASHRAE Fundamentals Handbook.
  - c2. The minimum amount of outdoor air for spaces served by HVAC systems shall meet the requirements of the International Mechanical Code and ASHRAE 62.1.
  - c3. Exhaust ventilation shall be provided for areas required by the International Mechanical Code and ASHRAE 62.1.
- d. Energy Efficiency:
  - d1. The design of the HVAC systems shall meet the applicable requirements of ASHRAE 90.1.
  - d2. The HVAC system equipment and components shall meet the applicable performance requirements of the ASHRAE 90.1.
- e. Fire Protection:
  - e1. The design of the HVAC systems shall meet the applicable requirements of NFPA 90A "Installation of Air Conditioning and Ventilating Systems."
  - e2. Duct penetrations and air transfer openings in fire barriers shall be protected with approved fire dampers installed in accordance with their listing as required by the International Mechanical Code and International Building Code.
- f. System Controls:
  - f1. The heating, ventilating, and air conditioning systems shall be controlled by locally mounted controls.
  - f2. The heating, ventilating, and air conditioning system controls shall meet the applicable requirements of ASHRAE 90.1.
  - f3. Acceptable suppliers for HVAC controls are Honeywell, Johnson Controls, Siemens, and Trane.
- g. Vibration Isolation and Control:
  - g1. Vibration isolation and control shall be in accordance with the guidance contained in ASHRAE Applications Handbook.

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- h. Acoustical Design of HVAC Systems:
  - h1. Acoustical design of the HVAC systems shall be in accordance with the guidance contained in ASHRAE Handbooks.
- i. Outdoor Air Intakes:
  - i1. Louvered intake's sills shall not be less than 28 inches from any outdoor roof surface or ground level.
  - i2. Intakes shall be located not less than fifteen feet from the discharge of any exhaust duct relief or fan.
  - i3. Intakes shall not be located in areas where products of combustion from vehicles may enter the building.
  - i4. All intake hoods, louvers, penthouses, and ducts shall have bird screens across the full opening.
  - i5. Maximum inlet velocity for intake mushroom hoods and goosenecks shall not exceed 300 feet per minute across the face area of the horizontal intake plane. Curb height should not be less than 24 inches.
  - i6. Plenums on the downstream side of intake louvers should be furnished with an access door and floor drain. Lighting shall be provided for plenums and louvered penthouses that handle airflows greater than 100,000 cfm. Louvered penthouses greater than 100 ft<sup>2</sup> of floor area should have two means of egress provided.
- 103.2 Functional System Design:
  - a. Absorber Building, Reactant Preparation Building, and gypsum Dewatering Building Heating & Ventilating System:
    - a1. The system shall consist of wall-mounted electric motor-operated dual combination louvers, wall or roof mounted ventilation fans, and electric unit heaters to maintain the area temperature within design limits year-round.
    - a2. Sequence of Operation
      - a2.1 Ventilation Fan Run Conditions: The fans shall run unless shutdown on safeties to maintain a building temperature cooling setpoint of 80°F (adj.). Alarms shall be provided for
        - a2.1.1 High Building Temp: If the building temperature is greater than the cooling setpoint by a user definable amount (adj.).
      - a2.2 Ventilation Fan Damper: The damper shall open anytime the fan runs and shall close anytime the fan stops.
      - a2.3 Ventilation Fan Status: The controller shall monitor the fan status. Alarms shall be provided as follows:
        - a2.3.1 Fan Failure: Commanded on, but the status is off.

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- a2.3.2 Fan in Hand: Commanded off, but the status is on.
- a2.4 Ventilation Louver Damper: The intake louver damper shall open anytime the fan runs and shall close anytime the fan stops.
- a2.5 Electric Unit Heater Run Conditions: The unit heaters shall operate to maintain a heating setpoint of 60°F (adj.).
- 103.3 HVAC System Calculations:
  - a. Calculation Format:
    - a1. The calculation shall contain the following sections: Issue Summary Sheet, Table of Contents, Purpose and Scope, Design Inputs, Assumptions, Methodology and Acceptance Criteria, Calculations, Results, References, and Attachments.
    - a2. Issue Summary Sheet - The calculation number, revision, project name, calculation title, preparer's name, reviewer's name, approver's name, and identification of pages added/revised shall be provided.
    - a3. Table of Contents - The total pages of each section shall be listed.
    - a4. Purpose and Scope - This section shall provide a clear statement of the scope of the calculation. The intended use of the calculation shall be provided to clarify the objective and to establish the basis for any limitations on where and how the results may be used.
    - a5. Design Input - This section shall contain a list of design inputs used in the calculation. The sources of design input shall be identified or listed in the Reference Section.
    - a6. Assumptions - This section shall include all assumptions and engineering judgments that are not readily apparent to technically qualified individuals in the subject area. The rationale used as the basis for assumptions shall be stated. Any assumptions that require verification at a later date shall be clearly identified as unverified. Calculations that contain unverified assumptions shall be tracked to assure closure.
    - a7. Methodology and Acceptance Criteria - This section shall describe the approach and acceptance criteria when such criteria are necessary to evaluate the results of the calculation. Computer programs should be identified here.
    - a8. Calculations - This section shall include the computations that generate the results or computer input for an engineering application program. The source of equations and formulas not in ordinary engineering usage shall be identified by reference. Technical references which are not readily available should have the appropriate sections included as an attachment to the calculation.
    - a9. Results - This section shall contain the results of the calculation and a statement of conclusions. The conclusion and recommendations shall be consistent with the purpose, scope, and assumptions of the calculation, shall indicate limitations, and shall be supported by the numerical results.

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- a10. References - This section shall list all reference material used as the source of design input, along with any additional material that clarifies the calculation methodology. References shall be identified by an appropriate document title, document number and revision, and/or date.
- a11. Attachments - This section shall list all attachments. Attachments may include computer output, supporting computations, unique forms of design input, validation documentation, and other related items.
- b. Heating & Cooling Load Calculations:
  - b1. CONTRACTOR shall calculate the heating and cooling loads for each system and/or area.
  - b2. The heating and cooling load calculations shall be prepared using the design principles given in the ASHRAE Fundamentals Handbook and ASHRAE 183.
  - b3. The calculation shall, as a minimum, address the following cooling loads:
    - b3.1 External walls, roofs, windows, doors, ceilings, and floors.
    - b3.2 Internal walls, ceilings, windows, doors, and floors.
    - b3.3 Lighting.
    - b3.4 People.
    - b3.5 Motors furnished by the CONTRACTOR and/or DISTRICT.
    - b3.6 Mechanical process equipment and ductwork furnished by the CONTRACTOR and/or DISTRICT.
    - b3.7 Piping furnished by the CONTRACTOR and/or DISTRICT.
    - b3.8 Electrical equipment furnished by the CONTRACTOR and/or DISTRICT.
    - b3.9 Supply and return fans in the system.
    - b3.10 Infiltration.
  - b4. The calculation shall, as a minimum, address the following heating loads:
    - b4.1 External walls, roofs, windows, doors, ceilings, and floors.
    - b4.2 Internal walls, ceilings, windows, doors, and floors.
    - b4.3 Infiltration.
    - b4.4 Outside air.
  - b5. The heating load calculation shall not take credit for internal heat gains from equipment, lighting, etc., when determining the required heating capacity of the system.
  - b6. The calculation shall address, as a minimum, the minimum system outside air required to:

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- b6.1 Meet the requirements of ASHRAE 62.1 and the International Mechanical Code.
- b6.2 Offset air exhausted from the space.
- b6.3 Meet space pressurization requirements.
- b6.4 Maintain the space within design temperature limits.
- b7. The calculation shall determine the performance of the fans, cooling coils, heating coils, and unit heaters required to maintain design conditions in the space.
- 103.4 HVAC Airflow Diagrams:
  - a. CONTRACTOR shall prepare HVAC airflow diagrams for each HVAC system.
  - b. The HVAC airflow diagrams shall show, as a minimum, equipment, major airflow paths, dampers, louvers, filters, coils, instrumentation, controls, and duct pressure class.
  - c. Equipment and components shall be identified with specific numbers.
  - d. Equipment shall be identified with assigned equipment titles.
  - e. Instrumentation and controls shall be identified with specific numbers.
- 103.5 HVAC System Physical Drawings:
  - a. CONTRACTOR shall prepare physical double-line drawings (plan) of all HVAC equipment, supports, accessories, and appurtenances. The drawings shall show locations and principal dimensions of all equipment and other details as may be required.
  - b. Equipment and components shall be identified with specific numbers.
  - c. Service openings, access doors and removable duct sections shall be identified on the drawings.
- 103.6 HVAC System 3-D Model:
  - a. CONTRACTOR shall prepare a 3-D model for the HVAC systems in accordance with Section 013330 and the following:
    - a1. CONTRACTOR shall utilize the project 3-D model to coordinate the physical space needs with other trades (electrical, mechanical, structural, fire protection, etc.)
    - a2. All objects modeled should equal or exceed the actual physical dimensions (i.e., pipe insulation, duct work stiffeners, equipment projections etc. shall be considered); however, judgment must be exercised on the level of detail of the 3-D model. The model should only be as detailed as necessary to perform the required design tasks.
    - a3. All modeled shapes shall be sufficiently detailed to reserve the space required for the object as well as the space required for operation and maintenance (O&M).
  - b. The reserved space shall include, as a minimum, the following:

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- b1. Clear unobstructed air space at ductwork and fan inlets and outlets.
- b2. Coil pull space.
- b3. Access door swings and/or pull space.
- b4. Clear unobstructed air space for louvers.
- b5. Space for duct, piping, and equipment supports.
- b6. Equipment removal paths.
- b7. Control panel door swings and required clear space.
- c. The following interface points shall be defined:
  - c1. Terminal points of HVAC system piping.
  - c2. Terminal points for electrical and control connections to contractor's equipment and components.
  - c3. Terminal points for penetrations through walls, floors, roofs, and ceilings.
  - c4. Terminal points for equipment, ductwork, and piping supports.

104. REFERENCE DOCUMENTS

- 104.1 Related standards, specifications, manuals and/or other publications of nationally recognized organizations are referenced herein. Methods, Equipment and materials shall comply with applicable or specified portions of referenced documents, in addition to Federal, State or local Codes having jurisdiction.
- 104.2 References to these documents shall be to the issue date as adopted in IBC 2006. If the document is not referenced in IBC 2006, then the reference is to the latest issue date of the document together with the latest additions, addenda, amendments, supplements, etc. in effect on the date of contract award.
- 104.3 AMCA – Air Movement and Control Association:
  - a. AMCA Publication 200 – Air Systems.
  - b. AMCA Publication 201 – Fans and Systems.
  - c. AMCA Publication 203 – Field Performance Measurement of Fan Systems.
  - d. AMCA Standard 500-D – Laboratory Methods of Testing Dampers for Rating.
  - e. AMCA Standard 500-L – Laboratory Methods of Testing Louvers for Rating.
  - f. AMCA Standard 204 – Balance Quality and Vibration Levels for Fans.
- 104.4 ASME – ASME International:
  - a. A 13.1 – Scheme for the Identification of Piping Systems.

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- b. B 31.1 – Power Piping.
  - c. B 31.3 – Process Piping.
  - d. B 31.5 – Refrigeration Piping and Heat Transfer Components.
  - e. B 31.9 – Building Services Piping.
- 104.5 ASHRAE – American Society of Heating, Refrigerating, and Air Conditioning Engineers:
- a. 15 – Safety Code for Mechanical Refrigeration.
  - b. 34 – Designation and Safety Classification of Refrigerants.
  - c. 52.1 – Gravimetric and Dust Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate.
  - d. 52.2 – Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size.
  - e. 62.1 – Ventilation for Acceptable Indoor Air Quality.
  - f. 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - g. 135 BACnet® – A Data Communication Protocol for Building Automation and Control Networks.
  - h. ASHRAE 1 – Guideline for the HVAC Commissioning Process.
  - i. ASHRAE Fundamentals Handbook.
  - j. ASHRAE Systems and Equipment Handbook.
  - k. ASHRAE Applications Handbook.
  - l. ASHRAE Refrigeration Handbook.
  - m. 183 – Peak Cooling and Heating Load Calculations in Buildings.
- 104.6 NFPA - National Fire Protection Association:
- a. 70 – National Electrical Code.
  - b. 72 – National Fire Alarm Code.
  - c. 90A – Installation of Air Conditioning and Ventilating Systems.
  - d. 90B – Installation of Warm Air Heating and Air Conditioning Systems.
  - e. 92A – Standard for Smoke Control Systems Utilizing Barriers and Pressure Differences.
  - f. 850 – Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations.



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- 104.7 SMACNA - Sheet Metal and Air Conditioning Contractors National Association:
- a. HVAC Duct Construction Standards - Metal and Flexible.
  - b. HVAC Duct Systems Inspection Guide.
  - c. HVAC Duct Leakage Test Manual.
  - d. Rectangular Industrial Duct Construction.
  - e. Round Industrial Duct Construction.
  - f. Seismic Restraint Manual: Guidelines for Mechanical Systems.
- 104.8 International Building Code
- 104.9 International Mechanical Code
- 104.10 International Fire Code
- 104.11 29 CFR 1910.1000 - Occupational Safety and Hazard Administration, Exposure to Nuisance Dust.
105. SUBMITTALS
- 105.1 Submit documents for review in accordance with the submittal requirements of this Specification.
- 105.2 Calculations:
- a. HVAC system heating and cooling load calculations.
- 105.3 Design Drawings:
- a. HVAC system airflow diagrams.
  - b. HVAC system physical drawings.
  - c. Control system drawings
- 105.4 Lists:
- a. Document List.
  - b. Equipment List.
  - c. Electrical Load List.
  - d. Instrument List.
- 105.5 HVAC System 3-D Model

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106.1 CONTRACTOR shall have methods in place to assure that items and services, including subcontracted items and services, comply with this Specification.

107. SEQUENCING

107.1 The HVAC system engineering and design work for this project shall proceed in the following sequence:

- a. Prepare and submit for review detailed engineering and design schedule.
- b. Prepare and submit for review system sizing calculations.
- c. Prepare and submit for review system airflow diagrams.
- d. Prepare and submit for review system piping and instrumentation diagrams.
- e. Prepare and submit for review 3-D models for the systems.
- f. Prepare and submit for review sequence of operation for the systems.
- g. Prepare and submit electrical load list.
- h. Prepare and submit for review system physical layout and piping drawings.
- i. Prepare and submit structural loading drawings and data.
- j. Prepare and submit drawings showing the size and location of system wall, floor, ceiling, and roof penetrations.

108. PREVENTION OF CORROSION

108.1 Metallic materials shall be protected against corrosion. Equipment enclosures shall be given rust-inhibiting treatment and standard finish by the manufacturer. Aluminum shall not be used in contact with earth, and where connected to dissimilar metal, shall be protected by approved fittings, barrier material, or treatment.

108.2 Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123/A 123M for exterior locations and cadmium-plated in conformance with ASTM B 766 for interior locations.

**PART 2 – PRODUCTS**

Not Applicable

**PART 3 – EXECUTION**301. PREPARATION

301.1 System Release for Construction:

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- a. Unverified assumptions contained in the calculations shall be verified prior to fabrication of associated system equipment and components.
  - b. 3-D Model interferences shall be resolved prior to release of the ductwork, piping, and equipment for construction.
- 301.2 Examination:
- a. Survey work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of existing conditions.
- 301.3 Coordination:
- a. CONTRACTOR shall coordinate the work of the different trades so that interference between piping, equipment, structural, and electrical work will be avoided.
  - b. All necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work properly shall be furnished complete in place at no additional cost to the DISTRICT.
302. INSTALLATION
- 302.1 Materials and equipment shall be installed in accordance with the requirements of the contract drawings and approved recommendations of the manufacturers.
- 302.2 Installation shall be accomplished by workers skilled in this type of work.
- 302.3 Installation shall be made so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.
- 302.4 Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- 302.5 Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components.
- 302.6 No installation shall be permitted which blocks or otherwise impedes access to any existing machine or system.
- 302.7 All hinged doors shall swing open a minimum of 120 degrees. The area in front of all access doors shall be clear a minimum of 3 feet. The area in front of all access doors to electrical circuits shall be clear the minimum distance to energized circuits as specified in OSHA Standards, Part 1910.333 (Electrical-Safety Related work practices).
- 302.8 Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations. All indicators, to include gauges, meters, and alarms shall be mounted in order to be easily visible by people in the area.
- 302.9 Equipment pads shall be provided and shall be of dimensions shown or, if not shown, they shall conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports.

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303.1 CONTRACTOR shall conduct all tests and inspections required to verify the furnished systems, equipment, components, and controls conform to the requirements of the specification and applicable codes, standards, and regulations.

303.2 CONTRACTOR shall perform testing, adjusting and balancing and control adjustments for all HVAC Systems and associated equipment / appurtenances. Testing of the system shall be in accordance the requirements of Section 230593

304. ADJUSTING AND CLEANING

304.1 Exposed surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish painting or are enclosed within the building structure.

304.2 Before final acceptance, mechanical equipment, including piping, ducting, and fixtures, shall be clean and free from dirt, grease, and finger marks.

305. PROTECTION

305.1 Use all means necessary at the job site to protect materials from dust, dirt, moisture and physical damage before and during installation.

306. RECORD DOCUMENTATION

306.1 Installation drawings shall be submitted. Drawings shall indicate overall physical features, dimensions, ratings, service requirements, layout and arrangement details

END OF SECTION